The conductors in use at the magazine are not in accordance with the present advanced state of knowledge on the subject of electricity, and they ought not to be allowed to remain in their present imperfect condition. There is, however, another serious objection to the exposed situation of the hill on which the magazine is situated. An enemy coming up the river would have a good opportunity of lodging a well directed shot, when the calamity from the elements which we have heretofore escaped, might overtake us by the hand of man.

In conclusion, no further proof of the value of a good conductor need be given, than the fact that since Sir S. Harris' arrangement of band-copper conductors to Her Majesty's vessels of war, no material damage has been sustained by them, whilst under the old system of chains over the ship's side, from the top of the mast to the water, an incredible number of lives and much property were annually sacrificed.

ART. XII.—*On Dove's Law of the Turning of the Wind, as illustrated and supported by Observations made at the Flagstaff Meteorological and Magnetic Observatory, Melbourne.* By Professor GEORGE NEUMAYER, Government Meteorologist and Director of the Magnetic Survey of Victoria.

(With Four Plates.)

[Read before the Institute 31st August, 1859.]

MR. PRESIDENT AND GENTLEMEN,—

The subject I have chosen to bring before you is one replete with interest, both in a theoretical and in a practical point of view. It is one which is calculated to yield some aid to an understanding and a comprehension of the causes of the currents in our atmosphere. It shows how intimately connected these phenomena are, if traced to their origin, while the superficial observer sees in them irreconcilable and even conflicting facts. The law of the turning of the winds gives an additional proof that a careful examination of such facts, and a simple and clear reasoning, will put us in possession of the necessary premises whereupon to found our conclusions, even anticipating the existence of laws in nature which will sometime be demonstrated. As to the practical interest attached to investigations on the currents of our atmosphere, I do not need to dwell at any length, as recent researches and discoveries in this branch of science have illustrated the value of what we have gained and what we still hope to gain.

Before entering into the enumeration of facts which tend to support Dove's "Law of Turning," it will be perhaps well, in order to prevent misunderstanding, to give in short outline the principles of this law, although I am quite aware that many of the members are quite conversant with them.

First of all, it must be understood that the southern coast of the Australian continent, from a geographical-meteorological point of view, is situated in the ec-tropical region of our globe, which is justly called the central system, or the region of the *oblique alternating winds.*

The continuous effect of the sun's heat gives rise to an ascending current of air within the tropical region (current ascendant) which, after having reached a great elevation, flows off towards the poles, the direction of the current being consequently in the southern hemisphere south, and in the northern hemisphere north, if we suppose our globe to have no rotation round its axis. The cold air from the polar regions rushes into the rarified space thus produced, which manifests itself by a current of air towards the north or the south, as we may suppose ourselves to be in the southern or northern hemisphere. These two currents pursue their courses above each other until the upper one of warm air descends into the lower regions of our atmosphere, and then makes its way on the surface of our globe. The latitude in which this takes place varies greatly throughout the year, following the declination of the sun, and is on an average 30 degrees at both sides of the equator.* Within those two parallels we have the intertropical, or, as some savans call it, the peripherical system of winds, and beyond them we have extending in both hemispheres towards the poles the central system, with its equatorial limit bounded by the *subtropical* belt, within the area of which falls the point of contact of the descending compensating wind varying throughout the year. The breadth of this latter girth is consequently given by the amplitude of the oscillations of the point of contact of the descending current. As soon as the compensating wind has reached the surface of the globe, it meets the current coming from the poles, and the relations between

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* The limits of the region of the trade winds depends greatly upon the configuration of the continents.

these two currents form the skeleton of the whole complex phenomena within the ec-tropical region, the principal features of which we have to explain for the southern hemisphere.* Throughout the remainder of my paper, therefore, I will refer to the phenomena as they present themselves in our hemisphere.

Up to the present time we have supposed the earth not to be in a state of rotation, and we found two currents in the southern hemisphere, the one from the equator at a great height above the equatorial belt of calms, and then descending to the earth's surface, moving towards the pole; and the second in a northern direction flowing from the pole towards the equator. But the rotation of our earth alters this state of things considerably, as we at once perceive, when entering into Hadley's theory of the cause of the "trade winds."

Columns of air proceeding from the poles in an originally northern direction will have a smaller rate of motion, in the sense of the rotation of our earth, than the parallel of latitude at which they arrive,† and an observer on that parallel participating in the rotation of the earth from W. to E., will find a resistance offered him by the comparatively stationary columns, which cannot follow at once at the same rate, and the result will be that the south direction will be changed into one between east and south.

Further, we find with regard to the columns of air moving from the equator to the pole that they will have *a greater rate of motion*, in the sense of the rotation of our earth, than the parallel of latitude at which they arrive, and an observer on that parallel will consequently feel a draft of air from the west, the northern direction of the current thus being altered into one between N. and W. It is the usual practice to call the S.E. current the "*polar current*," and that flowing from the N.W. direction the "*equatorial current*." The greater the difference of the rate of motion, in the sense of the rotation of our earth, between the place of observation and the column of air, the greater will be the deflection of the "equatorial current" towards W., and of the "polar current" towards E., under the supposition that the rate of meridianal motion of the column remains constant. Those parts of the column of air which arrive later at a place of observation

* I give these few explanations because the different recently published works have partly introduced confused ideas on this subject.

† As the motion is in a ratio of the radius of the parallel.

must consequently be more deflected than the earlier portions, therefore we arrive at the conclusion:—The "equatorial current" passes gradually over from a northern direction into N.W. and W., and the "polar current" from a southern direction into S.E. and E.

These two currents in the ec-tropical region are constantly alternating, forcing each other out of their way, and passing each other sideways, or hindering each other in their course. Their combined action will explain the remainder of the phenomena. We have explained that the "polar current" passed over into an easterly wind, that is to say, the vane turns from S. to S.E. and E., and this play would go on in repetition if the "equatoral current" did not make itself manifest. Its northerly direction, combined with the now easterly one of the polar current, will change, according to the parallelogram of forces, into E.N.E., N.E. and N.; and the "equatorial current" from the north passes over into N.W. and W., and the "polar current" will change the direction of the vane again into W.S.W., S.W. and S. Between N. and W. and S. and E. are the critical points in this course of the vane, as here the currents are "contending," and the vane is more frequently thrown back, while within the quadrants between S. and W. and N. and E. the revolution is rapidly accomplished. If we now comprehend all that has been said with one retrospective glance, we shall arrive at the following law:—

The phenomena of wind in their "chief features," as they occur within the centrical or ec-tropical system, can be explained by the combined action of two currents, which gradually move the vane from S. towards S.E., E., N.E., E., N, N.W., W., S.W. and S., that is to say, "*with the sun*."*

S.E. and N.W. are in this course of the revolution the critical quadrants.

This is the law of the turning of the wind, as laid down by Dove, for the southern hemisphere, and it is for observers impartially to collect facts which would either contradict or prove the accordance between the real and the theoretical speculations. The difficulty of the task has been considerably aggravated by a constant misunderstanding of the principles of Dove's Law. The law of storms, whirlwinds, and cyclones has been constantly confounded with the same, and results of observations were quoted as contradicting its principles, which,

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* In the northern hemisphere the contrary takes place, the vane moving from N. toward E., S., W., N., or also "*with the sun.*"

when properly examined, keeping in mind what was to be investigated, were found to be the strongest pillars whereupon this great law of the household of nature is based.

In proving the truth of the law of turning, we can pursue a two-fold mode—either we prove it by direct observations, that is, by carefully registering the anemometer, and then examining the "retrograde" and "direct" motions, if we understand by the latter the revolutions in the sense S., E., N., W., S., and under the former these in the sense S., W., N., E., S.; this being for the southern hemisphere. I have undertaken this task for the year from March 1858 to February 1859, according to the following method. The results are derived from hourly observations, and the registrations are noted within one point, or $11\frac{1}{4}$ degrees exactly.

Eight columns were formed to receive the positive and negative (direct and retrograde) motions of the vane from one hour to the following one. In case the vane passed through more than one point; the number of points were counted, and if more than four points, distributed on the different sextants through which the vane had passed, and here it was always understood that the vane had accomplished its way by the shorter route, *i.e.*, by less than sixteen points. In case that the vane went from one point of the compass to that diametrically opposite, the registration was not taken into account at all, as it could not be said which way the vane went, and such instances are marked by "*jumps*."

The positive and the negative motions have been summed up for each month, each quarter, and for the year, and the difference between the positive and negative number of points was taken as the balance of the one over the other, which, divided by 32, gives the number of whole revolutions in the one sense or the other.

The following table contains the results from such investigations:—

March, 1858	9·2	positive revolutions.
April, 1858	4·2	,, ,,
May, 1858............	2·1	,, ,,
June, 1858	2·6	,, ,,
July, 1858............	3·5	,, ,,
August, 1858	1·8	,, ,,
September, 1858	6·2	,, ,,
October, 1858	1·5	,, ,,
November, 1858	3·3	,, ,,

December, 1858	6·2	positive	revolutions.
January, 1859	4·8	,,	,,
February, 1859........	2·8	,,	,,

These figures give for the single quarters the sums :—

March to May, 1858 ..	15·5	positive	revolutions.
June to August, 1858 ..	7·9	,,	,,
Sept. to Nov., 1858 ..	11·0	,,	,,
Dec., 1858, to Jan., 1859	13·8	,,	,,

giving a total sum of 48·2 complete revolutions in the sense S., E., N., W., S., for the year, and an average of four revolutions in the direct sense during the month.

"Jumps" occurred on the following occasions, and under the following circumstances :—

Between S.E. by S. and N.W. by N. in the month of March.
,, W. by S. and E. by N. ,, ,, ,,
,, S.E. and N.W. ,, ,, ,,
,, E.S.E. and W.N.W. ,, ,, ,,
,, S.E. by E. and N.W. by N. on April the 13th.
,, E.S.E. and W.N.W. on April the 26th.
,, S.E. and N.W. on April the 29th.
,, S.E. and N.W. on May the 21st.
,, N.E. and S.W. on May the 25th.
,, S.E. and N.W. on May the 26th.
,, S.S.E. and N.N.W. on June the 23rd.
,, W. and E. on July the 4th.
,, N.E. and S.W. on August the 28th.
,, N.E. and S.W. on October the 6th.
,, S.S.E. and N.N.W. on October the 23rd.
,, N.W. by N. and S.E. by S. on October the 23rd.
,, E. by N. and W. by S. on October the 23rd.
,, N.W. by W. and S.E. by E. on November the 11th.
,, W. and E. on December the 3rd.
,, N. and S. on December the 10th.
,, S. and N. on February the 1st.
,, S.S.E. and N.N.W. on February the 2nd.
,, N. and S. on February the 6th.
,, S.S.E. and N.N.W. on February the 22nd.

By examining the single instances of "jumps," we find the following results. There were under twenty-four occurrences :—

14 from the S.E. to the N.W. quadrant, or *vice versa.*

5 from the N.E. to the S.W. quadrant.
3 from the N. to S., or *vice versa.*
2 from E. to W.

These figures illustrate, in strict conformity with the theory, how quickly the vane travels between E. and N. and W. and S., while it is retarded in the "critical quadrants," viz., S. and E. and N. and W.

The following table contains the analysis of the facts from which the above results have been derived :—

Between	Positive.		Negative.		Difference.
S. and S. E.	1159·5	..	942·5	..	217·0
S.E. and E.	668·5	..	535·5	..	133·0
E. and N.E.	816·5	..	627·5	..	189·0
N.E. and N.	1565·5	..	1351·5	..	214·0
N. and N.W.	1085·5	..	880·5	..	205·0
N.W. and W.	1012·0	..	858·0	..	154·0
W. and S.W.	1118·5	..	928·5	..	190·0
S.W. and S.	1362·0	..	1123·0	..	239·0
					1541·0
Sums of positive revolutions throughout the year					48·16

It is evident that the values, as given in the third column, ought to be equal; because, if the vane had to pass forty-eight times round the compass, an equal number of points must have been traversed in each octant, and these differences are, if we reduce the octants to quadrants, as follows :—

Between	S.E. and N.E.	350
"	N.E. and N.W.	419
"	N.W. and S.W.	344
"	S.W. and S.E.	456

We see by these results that the vane passes more rapidly over from S.E. to N.E., and from N.W. to S.W., than from N.E. to N.W. and S.W. and S.E.

The relative frequency of the winds affords a means to arrive at the same conclusion, that the quadrants between N.E. and N.W.; S.W. and S.E. are the critical quadrants, *i.e.*, the contesting field of the alternating currents.

The following numbers express the relative values of the occurrences of the different winds, if we adopt the number of registrations of eastern winds as unite:—

S.	4·3	Between N.E. and N.	5·5
Between S. and S.E.	3·1	N.	5·5
S.E.	2·4	Between N. and N.W.	3·5
Between S.E. and E.	1·6	N.W.	2·6
E.	1·0	Between N.W. and W.	2·2
Between E. and N.E.	1·9	W.	3·3
N.E.	4·3	Between W. and S.W.	3·7
		S.W.	2·7
		S.W. and S.	3·8

Consequently, by giving the means we have—

Between S.W. and S.E.	3·26
„ S.E. and N.E.	2·24
„ N.E. and N.W.	4.28
„ N.W. and S.W.	2·70

We readily perceive that the celerity with which the vane travels through each quadrant is in an inverted ratio with the frequency, and consequently that between S.E. and N.E., N.W. and S.W., the vane travels more easily than between S.W. and S.E., N.E. and N.W. The two latter quadrants form the contesting fields. Before leaving the direct proofs, as derived from yearly observations, I should like to add a few words having reference to the mean directions of the wind in this country.

In computing this quantity for the year, the formula given in statics for finding the mean direction, when several powers, acting in one and the same plane, attack a point, has been used. The force of the wind was taken as equal to *one*, and the relative frequency as the components. By this method I obtained the mean direction of the wind for the year to be

N. 38° 54′ W.

Taking the relative force into consideration, these results will be slightly changed, as I shall show at another opportunity. I have only endeavored to prove the greater predominance of the "Equatorial" over the "Polar Current."

Following the mean direction of the wind through the different quarters, we find—

For the quarter March to May	N. 50° 45′ E.
„ „ June to August	N. 14° 31′ W.
„ „ September to Nov.	S. 80° 20′ W.
„ „ December to Feb.	S. 17° 44′ W.

We see by these results that the mean direction moved round from N.E. to S. by W. during the year; and if we recollect the number of revolutions during the different seasons, as given in the early part of this paper, we are struck with the fact that the least number of revolutions occur when the mean direction for the quarter nearly coincides with the mean direction for the year, and that the number increases as the former recedes from the latter, in the sense of the direct revolutions.

After having given the results of the yearly observations bearing upon the subject before us, I have thought it also advisable to examine the mean direction of the wind for each day in a certain month, with the view of illustrating still further the law of the turning of the wind.

The quantities used are those given in the first column of Table IV. [*Vide* page 120, and Plate I.]

The month of April, 1859, was selected, because it is an average month; with regard to the number of revolutions, which were 3·72, this number closely corresponds with that for April, 1858, viz.:—4·0, and the latter number is nearly the average number of direct revolutions per month throughout the year.

If we analyse the directions given in Table IV., and divide them into positive and negative, according to the principles laid down above, when speaking of the motions of the vane in general, and taking, as jumps, all those changes in direction which are within 5° of 180° distant from each other, we obtain the following results:—Positive sense, 990° 26′; negative sense, 686° 25′; and one jump between the 19th and 20th of the month, consequently if x represents the jump, we obtain as the result 304° 1′ + x direct revolutions of the wind more than negative ones. On examining the nature of the jump we see that the wind went around from N.E. to N., N.N.W., S.W. by S., S., and S.S.E., consequently, the motion of the mean direction could not have been retrograde. The jump being therefore considered positive, we have 490° 54′ as the total number of degrees through which the mean direction veered in the sense S.E., N., W., S., in advance to the revolutions in the sense S.W., N.E., or 1·36 revolutions, which will be as nearly as possible the mean value of the revolutions of the mean direction in the course of a month.

Having given these facts, which directly support the law of the turning of the winds for the southern hemisphere, I now proceed to a second and indirect mode of proof; but allow me first to make a few explanatory remarks.

If the phenomena we observe with the weather vane are in their principal features the result of two contending currents of air, namely, the *equatorial* and the *polar currents*, it is a matter of necessity that the various meteorological instruments should be differently affected by the prevailing properties of those currents.

The *polar* current coming from the antarctic regions must be cold, dense, and dry. The equatorial, on the contrary, coming from the belt of calms, must be warm, light, and moist.

The barometer will therefore stand high with the polar current and low with the equatorial.

The thermometer will be low with the polar current and high with the equatorial.

The tension of aqueous vapour will be slight with the polar current and great with the equatorial.

The different intermediate winds will, of course, have corresponding influences on the meteorological instruments.

It is necessary that we call to mind the different principles of the law, and that we thoroughly understand the illustrious *savant* who founded these theories, when he says, "*a south-east wind comes further from the south than the south wind itself.*" The amount of deflection offers a criterion as to the difference in latitude between the place of observation and the point whence the current of air comes, and certainly the S.E. being more deflected than the S., must have more of the qualities of the polar current than the S. With S.E. wind we should have the highest barometer, the lowest temperature, and the least tension of aqueous vapour. As the wind recedes from this point, the barometer begins to fall, the thermometer to rise, and the tension of aqueous vapour to increase, in consequence of the approaching equatorial current.

Analogously to the conclusions we arrived at with regard to the polar current, we might expect that the lowest state of the barometer, and the maximum of temperature and aqueous pressure would coincide with N.W.; thus the extremes of the phenomena are given, and between them the instruments must show regular curves. For the purpose of illustrating these facts, I could have used the results of yearly observations, but I content myself with laying before you those of but one month, and for this purpose I again selected the month of April, 1859, because the means of the pressure of air, and of aqueous vapour, and of temperature of air, nearly coincide with the mean values for the year, viz.: 29·881 inches, 0·365 inch, and 58·3 degrees.

Glancing over the mean values of the different elements, as shown in Table IV. (*vide* Plates I. and II.), we perceive at once that a maximum of the barometer is constantly accompanied or immediately followed by a minimum in temperature of air and tension of vapour, as on the 5th, 13th, and 21st, the mean directions of the wind being, for those days respectively, S.W., S.W., and S.E. :—

Bar.	Ther.	P. V.	Wind.
5th—30·000 ..	60·5 ..	0·338 ..	S.W.
13th—30·034 ..	52·5 ..	0·278 ..	S.W.
21st—30·292 ..	52·4 ..	0·242 ..	S.E.

Further, we see that a minimum of the barometer coincides with a maximum in temperature and aqueous pressure on the 3rd, 11th, 19th, 30th :—

Bar.	Ther.	P. V.	Wind.
3rd—29·809 ..	62·9 ..	0·279 ..	N.W.
11th—29·555 ..	55·4 ..	0·320 ..	N.N.W.
19th—29·847 ..	59·5 ..	0·286 ..	N.E.
30th—29·772 ..	70·1 ..	0·324 ..	N.

In the first instance we have the polar current with its properties, and in the last the equatorial; the intermediate days show signs of the combined action of both currents. The pressure of *dry air* accommodates itself closely to the pressure of air, as shown in the respective columns, and the amount of cloud reached its maximum at the same time as the barometer, and the rain fell abundantly when the temperature was very low (52·0).

If such diagrams and tables are calculated to illustrate the simultaneous occurrences in the various meteorological elements, they must still fail to exhibit the law of alternating currents as closely as we could wish; another mode is therefore necessary. I refer to the construction of wind-roses, or barometric, thermometric and atmic cards, the nature and construction of which I shall endeavour to explain in as simple a manner as possible.

By taking the means of all the readings of the barometer, thermometer, or hygeometer, when the wind blew from a certain point of the compass, we obtain the mean reading of these meteorological elements for that point; and by taking the mean in this way for each point of the compass, we obtain what is called a barometric, thermometric or atmic wind-rose. (*Vide* Plate III.) But I must mention here, that we have first to eliminate certain oscillations, the values of which are already known to us, for instance, the horary variations; in order to accomplish this object, I pursue the following course. As mentioned in the commencement of this paper, all results are derived from hourly observations, so that each observation will have to be corrected by a quantity equal to the amount of oscillation due to the hour of observation. These are the principles according to which Tables I. and II.—[*vide* pages 116-117, and Plate IV.]—have been constructed, and a diagram showing the states of the meteorological instruments at different periods of the revolution of the wind in a direct sense.

Barometer.—The barometer is highest at S.E., passes over from rising to falling, continues to fall E., N.E., N., and reaches its minimum when the wind blows from N.N.W.; it then passes over from falling to rising, continues to rise through W.S.W. and S., and reaches its maximum at S.E. again.

Thermometer.—The temperature is lowest when the wind blows from S.E., and passes in S.E. from falling to rising, continues to rise in E., N.E., N., and reaches its maximum in N.N.W., when it passes over from rising to falling, and continues to fall in W., S.W. and S.

Aqueous Vapor.—The tension of aqueous vapor is least in S.E., and rises in passing through N.E. and N. The western hemisphere clearly shows local influences as the tension does not decrease towards south, but increases again on account of the great area of ocean towards the west and south. Pressure of dry air coincides almost entirely with pressure of air.

Thus we have an indirect proof of the truth of the law of the turning of the wind, furnished by observations of one month only.

The different meteorological instruments give us to understand which current prevails at a certain time, a point which it is sometimes very difficult, if not impossible, to do without their help.

It must be borne in mind that the results obtained from a month's observations only, are greatly affected by disturbances, because of the small number of observations that have been made in some points of the compass. These deficiencies will be removed if we have to do with observations extending over a longer period. In another place I shall bring before the scientific world results deduced from one year's observations, bearing on the same subject.

In closing this subject, I cannot pass over in silence one remarkable fact, viz., that the positive electricity-rose—[*vide* Plate II.]—nearly coincides with the pressure of air, which fact may perhaps lead to some clue for the solution of this remarkable, but still mysterious agency in nature.

Allow me to read a passage from a log kept by Captain Gilfillan, late master of the schooner "Yarra," which illustrates in a most striking manner the general course of the wind and weather on this coast. He states as follows:—

"It will be seen that we had some heavy weather during this voyage. The first breeze was when off Cape Otway, which lasted up to midnight of the 9th, when the wind shifted from northward to south by the west, and taking its regular course after falling light round the east to the north, being lightest at east. It continued to haul round to S.W. again, and fell calm, and was lightest when E.N.E., continuing to follow round to west by the north, and it blew hardest when between W.N.W. and S.W., from which quarter we experienced some very heavy hail squalls. It then continued sometime at S.W., and then hauled back by the west to the north, after which it fell light and came to N.E. There the breeze increased, and hauled round to N.W. by the north, and blew hard. It then gradually became calm, again sprung up from N.W. light, fell then calm, and in the calm shifted to S.W. light, when we reached Adelaide."

The question may be raised, why does the wind at all go back, and not pursue its course continually according to the law? To this I may reply, firstly, why does a balance not come at once to a state of rest after an oscillation? Secondly, the retrograde motion may also be caused by hurricanes, in which the vane may turn with or against the sun, according to the side of the storm on which we are. Furthermore, the land and sea breezes, hot winds, and local influences must necessarily cause irregularities; and if in spite of all these interferences we can prove such a surplus of direct revolutions, we cannot but feel surprised that the law makes itself manifest so clearly as it does.

Another objection which may be raised is, how is it to be proved that the alternating currents are passing each other sideways? Why do they alternate at all? Why does not one prevail for ever? And what law rules this change in winds?

These are questions containing problems which to attempt to solve would be rather premature. A system of meteorological observations, in which the means are taken for every five days, is now in progress of organisation in this colony, and I hope that the neighboring colonies will join us in our endeavours, as we may be sure that such exertions cannot but lead to the thorough explanation of the interesting phenomena I have this evening brought under your notice.

TABLE I.

[*Vide Plate III.*]

MONTH OF APRIL, 1859.

MEANS FOR EACH POINT OF THE COMPASS.

Direction of Wind.	Thermometer.	Barometer.	Vapour.	Dry Air.	Number of Registrations.
S.	59·04	30·103	0·327	29·776	46
S. by E.	61·90	30·086	0·353	29·733	12
S.S.E.	52·60	30·154	0·266	29·888	9
S.E. by S.	57·70	30·129	0·355	29·774	6
S.E.	51·70	30·180	0·277	29·903	14
S.E. by E.	57·50	30·139	0·269	29·870	12
E.S.E.	65·70	30·133	0·316	29·817	5
E. by S.	62·50	30·304	0·246	30·058	2
E.	57·50	30·048	0·329	29·719	10
E. by N.	52·40	30·039	0·321	29·718	6
E.N.E.	60·90	30·002	0·276	29·726	13
N.E. by E.	53·16	30·058	0·241	29·817	5
N.E.	59·90	29·971	0·295	29·676	62
N.E. by N.	59·50	29·907	0·311	29·596	24
N.N.E.	65·90	29·862	0·295	29·567	35
N. by E.	66·00	29·867	0·308	29·559	21
N.	63·50	29·859	0·300	29·559	64
N. by W.	64·70	29·849	0·297	29·552	16
N.N.W.	73·10	29·902	0·299	29·603	27
N.W. by N.	66·50	29·845	0·293	29·552	12
N.W.	63·90	29·958	0·299	29·659	22
N.W. by W.	64·60	29·981	0·320	29·661	9
W.N.W.	56·50	29·989	0·319	29·670	15
W. by N.	54·50	29·989	0·318	29·671	18
W.	59·10	30·013	0·315	29·698	63
W. by S.	58·20	29·974	0·335	29·639	21
W.S.W.	56·20	29·992	0·330	29·662	41
S.W. by W.	56·80	30·040	0·304	29·736	14
S.W.	58·80	30·015	0·322	29·693	39
S.W. by S.	61·80	30·031	0·353	29·678	6
S.S.W.	60·50	29·991	0·316	29·675	16
S. by W.	60·10	30·075	0·322	29·753	16

TABLE II.

[*Vide Plate III.*]

MONTH OF APRIL, 1859.

MEANS FOR EACH POINT OF THE COMPASS.

Direction of Wind.	Atmospheric Electricity.	Force of Wind.	Amount of Cloud.	Number of Hours of Rain.
S.	2·89	1·90	6·10	0·60
S. by E.	3·53	1·40	5·30	0·00
S.S.E.	6·22	1·30	7·30	0·00
S.E. by S.	4·73	1·07	9·30	0·00
S.E.	5·10	1·20	5·00	0·00
S.E. by E.	5·02	1·00	6·60	0·00
E.S.E.	4·76	0·80	8·00	0·40
E. by S.	7·39	1·00	9·00	0·00
E.	4·57	0·95	4·75	0·30
E. by N.	4·36	1·25	4·80	0·40
E.N.E.	4·21	1·50	3·80	0·00
N.E. by E.	4·65	1·00	2·00	0·00
N.E.	3·73	1·80	4·25	0·70
N.E. by N.	3·08	1·90	5·90	0·00
N.N.E.	2·62	3·00	5·40	0·10
N. by E.	2·04	2·70	5·90	0·00
N.	2·27	3·15	5·50	0·00
N. by W.	1·87	2·90	6·90	1·00
N.N.W.	2·23	2·20	6·60	3·40
N.W. by N.	1·90	1·60	8·30	1·00
N.W.	2·63	1·60	4·60	0·20
N.W. by W.	2·27	1·50	9·30	2·50
W.N.W.	2·00	2·00	8·70	0·80
W. by N.	1·82	2·20	7·90	0·50
W.	2·29	2·20	8·10	1·80
W. by S.	2·04	2·30	8·70	0·80
W.S.W.	2·60	2.50	8·45	4·30
S.W. by W.	2·32	2·50	8·10	2·80
S.W.	3·23	2·60	7·70	2·80
S.W. by S.	2·53	2·30	8·60	1·00
S.S.W.	3·35	2·30	6·20	0·30
S. by W.	3·85	2·80	5·60	0·70

TABLE III.

[*Vide Plate IV.*]

TABLE SHOWING THE HORARY VARIATIONS IN THE DIFFERENT METEOROLOGICAL ELEMENTS, AS DERIVED FROM OBSERVATIONS TAKEN IN THE MONTH OF APRIL, 1859.

Time—Hours.	Pressure of Air.	Pressure of Vapour.	Pressure of Dry Air.	Temperature of Air.	Temperature of Soil.	Force of Wind.	Amount of Cloud.	Electric Tension, Positive.	Hours of Rain.	Hours of Dew.	Hours of Fog.
	Inch.	Inch.	Inch.	Deg. Fah.	Deg. Fah.						
Midnight	29·999	0·306	29·693	54·3	52·8	2·00	5·50	3·05	0·50	2·00	0·00
1	29·993	0·304	29·689	53·6	52·4	1·80	6·30	2·59	0·50	2·00	0·00
2	29·983	0·306	29·677	53·1	51·9	1·70	6·10	2·58	1·20	2·00	0·00
3	29·972	0·305	29·667	52·8	51·6	3·30	6·20	2·42	2·00	3·50	0·00
4	29·974	0·299	29·675	52·4	50·9	1·80	5·95	2·59	1·90	4·50	0·00
5	29·980	0·300	29·680	52·1	50·5	1·85	6·40	2·74	1·30	3·50	0·00
6	29·991	0·298	29·693	51·8	50·4	1·70	7·00	3·19	1·70	2·50	0·00
7	30·002	0·307	29·695	52·6	52·2	1·90	7·30	4·28	2·20	2·70	0·00
8	30·012	0·313	29·699	55·3	57·6	2·00	6·90	4·61	1·30	0·00	0·00
9	30·015	0·312	29·703	59·2	64·7	2·60	7·10	3·80	0·30	0·00	0·00

TABLE III.—(CONTINUED.)

Time—Hours.	Pressure of Air.	Pressure of Vapour.	Pressure of Dry Air.	Temperature of Air.	Temperature of Soil.	Force of Wind.	Amount of Cloud.	Electric Tension, Positive.	Hours of Rain.	Hours of Dew.	Hours of Fog.
	Inch.	Inch.	Inch.	Deg. Fah.	Deg. Fah.						
10	30·009	0·319	29·690	62·7	71·9	2·70	6·70	2·77	0·50	0·00	0·00
11	30·003	0·309	29·694	64·5	75·4	2·70	7·00	2·11	0·40	0·00	0·00
Noon	29·987	0·315	29·672	65·1	77·4	2·70	7·30	2·37	0·50	0·00	0·00
1	29·969	0·310	29·659	66·2	79·15	2·50	6·80	2·31	0·00	0·00	0·00
2	29·957	0·317	29·640	66·0	78·20	2·60	7·20	2·15	0·20	0·00	0·00
3	29·953	0·311	29·642	65·8	75·90	2·40	7·10	1·94	1·10	0·00	0·00
4	29·951	0·307	29·644	64·8	70·3	2·30	6·40	2·17	1·00	0·00	0·00
5	29·957	0·311	29·646	62·7	64·2	2·00	6·30	3·09	0·80	0·00	0·00
6	29·974	0·317	29·657	60·5	60·2	1·90	6·60	3·58	1·00	0·00	0·00
7	29·985	0·314	29·671	59·2	58·4	1·70	6·40	3·95	0·60	0·00	0·00
8	29·993	0·319	29·674	57·8	56·9	1·90	6·10	3·76	2·50	0·00	0·00
9	29·998	0·317	29·681	57·0	55·9	1·70	5·80	3·90	1·90	1·00	0·00
10	29·996	0·310	29·686	56·0	54·8	1·70	6·15	3·69	1·80	1·50	0·00
11	29·988	0·309	29·679	53·9	53·9	1·90	5·70	3·06	1·50	0·60	0·00

TABLE IV.

[*Vide Plates I and II.*]

DAILY MEANS OF THE DIFFERENT METEOROLOGICAL ELEMENTS FOR THE MONTH OF APRIL, 1859.

Days of the Month.	Mean Direction of Wind.	Pressure of Air.	Temperature of Air.	Temperature of Soil.	Pressure of Vapour.	Pressure of Dry Air.	Rain. Inches.	Rain. Hours.	Hours of Fog.	Hours of Dew.	Force of Wind.	Amount of Cloud.	Electricity.	Ozone.
	° ′	inches.	deg. Fahr.	deg. Fahr.	inches.	inches.	inches.	hours.	hours.	hours.				
1	94 29	30·123	58·6	68·1	0·320	29·803	0·000	0·0	0	3·5	0·6	1·90	3·14	1·00
2	156 19	30·028	67·7	71·9	0·226	29·802	0·000	0·0	0	0·0	3·2	2·10	3·22	—
3	230 49	29·809	67·9	68·2	0·279	29·530	0·000	0·0	0	0·0	4·9	5·00	2·97	0·88
4	251 34	29·936	58·2	60·2	0·274	29·662	0·000	0·0	0	0·0	2·5	6·00	2·37	1·00
5	283 2	30·000	60·5	66·4	0·338	29·662	0·000	0·0	0	0·0	1·4	7·40	1·37	—
6	326 24	29·946	62·3	67·3	0·355	29·591	0·000	0·0	0	0·0	0·8	8·30	2·53	1·17
7	358 1	29·925	60·3	63·1	0·399	29·526	0·025	2·8	0	0·0	1·4	8·80	2·61	1·00
8	319 28	29·967	55·7	60·4	0·317	29·650	0·034	2·0	0	1·6	1·4	4·30	3·27	4·00
9	213 42	29·856	55·7	59·7	0·288	29·568	0·000	0·0	0	5·5	1·1	7·10	2·63	3·00
10	177 16	29·702	61·0	61·8	0·306	29·396	0·000	2·8	0	0·0	3·3	8·00	1·59	1·67
11	195 5	29·555	55·4	56·6	0·320	29·235	0·236	2·5	0	0·0	3·0	7·00	2·84	3·33
12	274 31	29·819	55·9	55·5	0·355	29·464	0·264	2·9	0	0·0	4·06	8·60	2·17	—
13	307 20	30·034	52·5	50·9	0·278	29·756	0·407	10·0	0	0·0	4·50	8·40	2·73	5·83
14	314 26	30·184	51·2	50·3	0·290	29·895	0·166	1·8	0	0·0	2·3	9·19	2·86	3·50
15	253 25	30·156	54·5	54·2	0·289	29·867	0·000	0·0	0	0·0	1·8	9·00	1·90	3·50

TABLE IV.—(CONTINUED.)

Days of the Month.	Mean Direction of Wind.	Pressure of Air.	Temperature of Air.	Temperature of Soil.	Pressure of Vapour.	Pressure of Dry Air.	Rain. Inches.	Rain. Hours.	Hours of Fog.	Hours of Dew.	Force of Wind.	Amount of Clouds.	Electricity.	Ozone.
	° ′	inches.	deg. Fahr.	deg. Fahr.	inches.	inches.	inches.	hours.	hours.	hours.				
16	300 26	30·191	56·5	56·1	0·344	29·847	0·000	0·0	0	0·5	1.5	9·10	2·19	2·75
17	300 6	30·119	54·7	55·7	0·296	29·823	0·000	0·0	0	0·5	0·68	8·80	2·66	2·75
18	160 29	29·964	53·7	59·6	0·271	29·693	0·000	0·0	0	7·7	1·4	0·00	3·59	1·17
19	152 9	29·847	59·5	62·2	0·286	29·561	0·000	0·0	0	0·0	3·0	3·20	2·54	0·50
20	339 2	30·167	54·3	59·0	0·262	29·905	0·027	0·5	0	0·0	3·5	5·20	4·36	2·00
21	31 47	30·292	52·4	55·9	0·242	30·050	0·000	0·0	0	0·0	1·3	5·60	5·11	1·00
22	90 20	30·166	51·1	55·2	0·259	29·907	0·000	0·0	0	0·0	0·8	7·90	6·40	2·08
23	312 37	30·037	51·8	54·8	0·275	29·762	0·000	0·0	0	0·0	1·0	7·60	4·33	1·33
24	174 14	30·086	57·6	59·3	0·338	29·748	0·001	0·0	0	0·0	0·5	9·10	3·53	3·67
25	157 35	30·000	59·6	64·5	0·315	29·685	0·000	0·0	0	5·5	1·4	2·50	3·57	—
26	282 16	29·933	61·9	67·1	0·347	29·586	0·000	0·0	0	0·0	0·8	3·70	4·03	0.00
27	4 55	30·023	59·4	65·3	0·409	29·614	0·000	0·0	0	1·0	1·0	7·90	4·15	3·00
28	171 11	29·996	63·7	66·7	0·366	29·630	0·000	0·0	0	0·0	2·2	7·40	2·17	4·00
29	162 54	29·930	67·8	68·5	0·346	29·584	0·000	1·7	0	0·0	2·8	7·30	1·47	2·50
30	176 3	29·772	70·1	68·2	0·324	29·448	0·000	0·0	0	0·0	4·1	9·30	1·01	1·00
Means	217 40	29·985	58·38	61·09	0·310	29·675	1·160	27·00	0	25·8	2·07	6·52	2·99	2·22

NOTE.—The mean direction of the wind is given in degrees and minutes, starting from south and counting round the circle in the sense S.E., N.W., S. (positive direction).

TABLE V.

[*Vide* Plate II.]

MONTH OF APRIL, 1859.

DAILY EXTREMES IN THE DIFFERENT METEOROLOGICAL ELEMENTS.

Days of the Month.	Pressure of Air.		Pressure of Vapour.		Temperature of Air.	
	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.
	inch.	inch.	inch.	inch.	deg. Fahr.	deg. Fahr.
1	30·169	30·062	0·437	0·251	70·6	44·4
2	30·112	29·911	0·309	0·147	85·5	50·2
3	29·937	29·700	0·492	0·111	84·0	52·3
4	29·975	29·912	0·347	0·225	67·1	49·0
5	30·039	29·965	0·367	0·269	67·0	54·3
6	29·998	29·893	0·386	0·324	72·1	56·5
7	29·992	29·883	0·446	0·350	66·1	55·7
8	30·022	29·909	0·361	0·281	65·9	49·0
9	29·929	29·811	0·340	0·267	67·4	45·8
10	29·855	29·514	0·392	0·274	69·8	50·8
11	29·679	29·491	0·396	0·251	64·8	49·6
12	29·955	29·672	0·422	0·275	62·3	50·3
13	30·186	29·881	0·376	0·237	56·6	48·0
14	30·213	30·142	0·327	0·246	55·5	47·0
15	30·191	30·129	0·334	0·265	60·9	49·8
16	30·225	30·136	0·366	0·304	62·7	52·3
17	30·189	30·056	0·322	0·179	62·7	47·9
18	30·046	29·885	0·299	0·232	68·5	39·8
19	29·933	29·745	0·429	0·249	71·6	50.0
20	30·313	29·955	0·345	0·193	60·2	49·0
21	30·336	30·258	0·255	0·231	59·8	46·9
22	30·245	30·081	0·289	0·233	61·6	42·3
23	30·076	30·004	0·317	0·239	62·4	43·1
24	30·140	30·016	0·377	0·227	66·1	49·1
25	30·112	29·908	0·356	0·285	76·0	46·0
26	29·980	29·882	0·447	0·292	73·7	53·3
27	30·075	29·965	0·439	0·379	67·5	55·0
28	30·040	29·944	0·400	0·342	75·0	53·0
29	29·965	29·872	0·402	0·304	76·5	60·7
30	29·871	29·677	0·409	0·290	74·8	66·1
Means	30·060	29·908	0·373	0·258	67·82	50·24